Human Performance Improvement (HPI) Event Analysis

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December 2008

Basic EA Flow

1 - Introduction

Course Overview

HP Review & Resources

Why HPI Approach to EA

2 - Investigation

Interviews

Record Reviews

Observations

Investigation (What)

3 - Analysis

Error Precursors

Flawed Defenses

Latent Conditions

Analysis (Why)

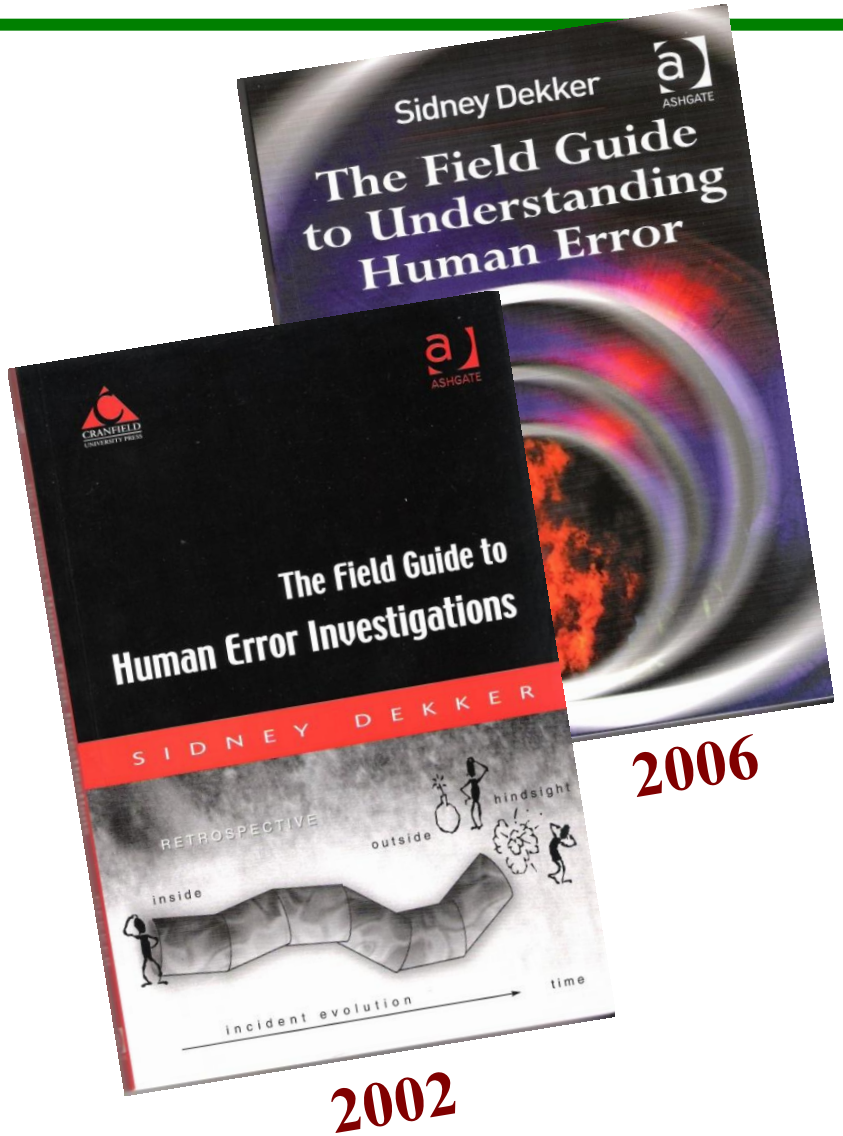
4 - Fix what can and needs to be fixed!

Recommendations Lessons-To-Learn

Topic 1: Why Take an HPI Approach?

"An Introduction to HPI Event Analysis"

Excellent References!



HPC Reference Materials

NUCLEAR EXECUTIVE LEADERSHIP TRAINING

Human Performance Handbook

HUMAN PERFORMANCE IMPROVEMENT
CONCEPTS AND PRINCIPLES
September 2007

Human Performance Tools for Individuals, Work Teams, and Management

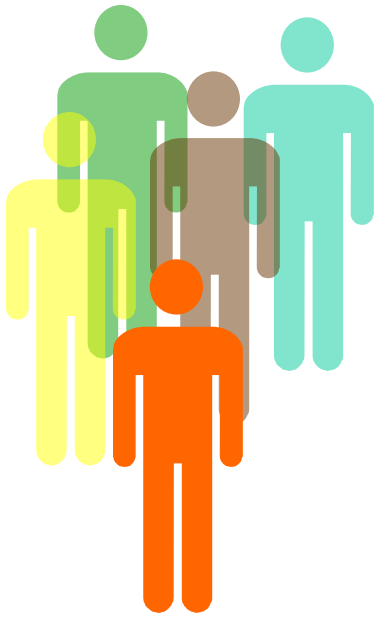
A Good Practice Guide for
Anticipating, Preventing, and Catching
Human Errors and Identifying
Latent Organizational Weaknesses

HUMAN PERFORMANCE IMPROVEMENT
METHODS AND TECHNIQUES
September 2007

http://www.hss.energy.gov/csa/csp/hpc/

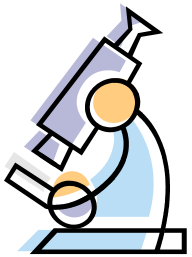
HP Terminology

- Event
- Error Precursors and Error-Likely Situations
- Flawed Defenses
- Human Error, Mistakes, and Violations
  - Active and Latent
- Initiating Action
- Latent Organizational Conditions
- Performance Modes

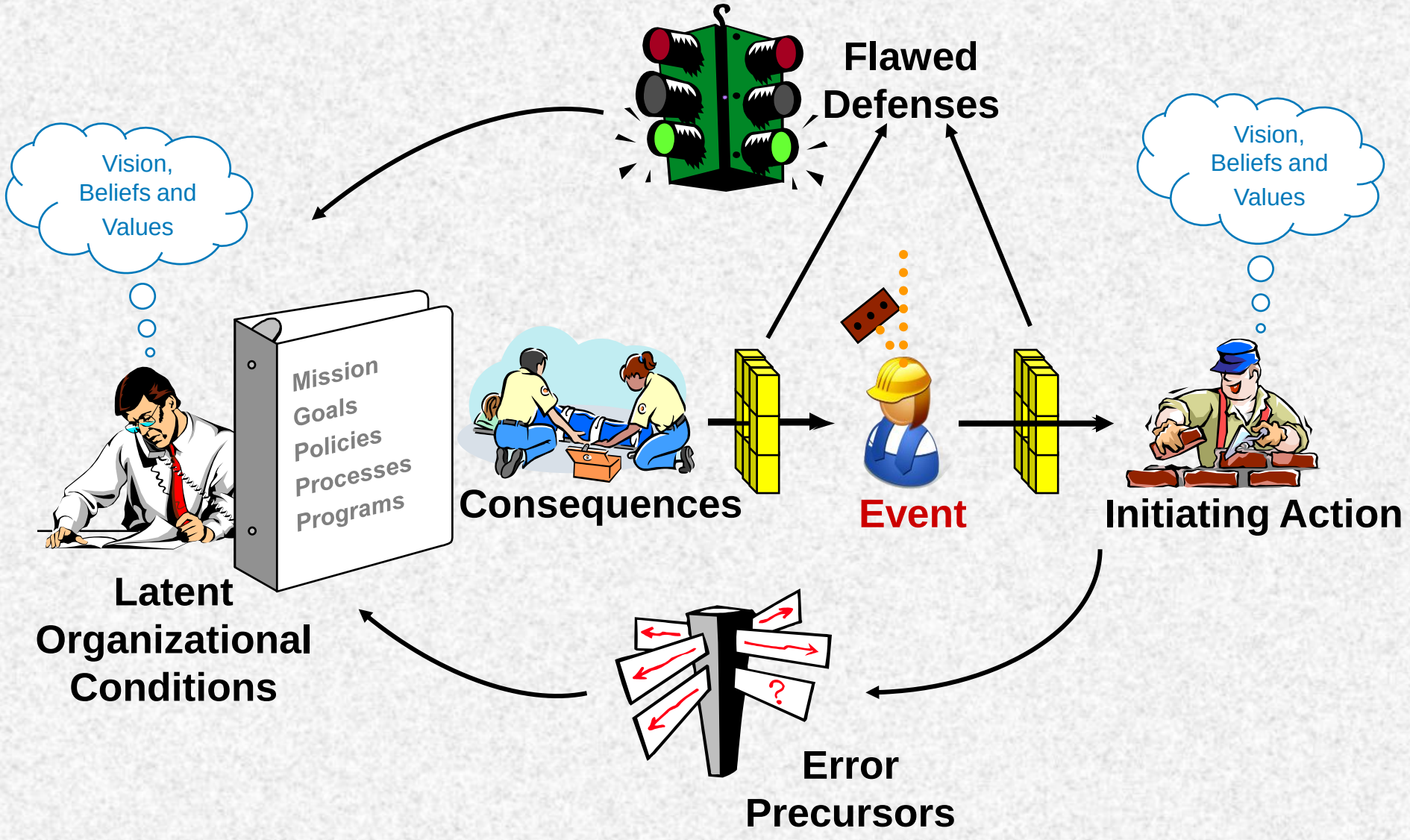


Traditional Approach to Addressing Human Error

- Focus on the initiating action that caused the incident (active error, violation or correct action).
- Zero in on those individuals involved.
- Determine what they did wrong — acts of commission or omission?
- Reprimand the wrong-doers, add more controls to the procedure, and re-train!



Anatomy of an Event

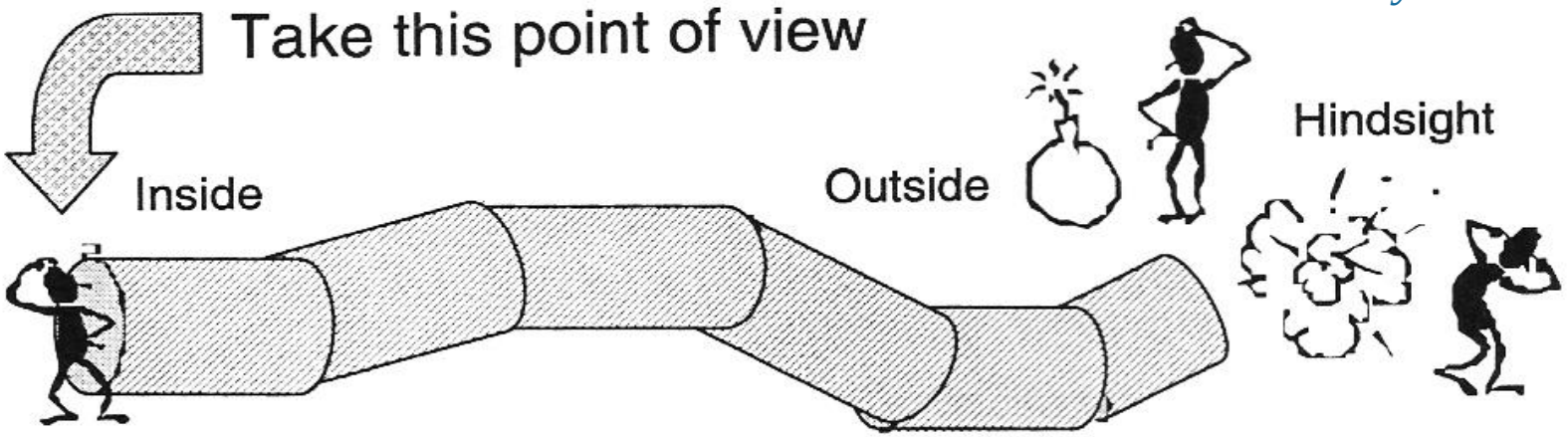


HP Approach to Addressing Human Error

NUCLEAR EXECUTIVE LEADERSHIP TRAINING

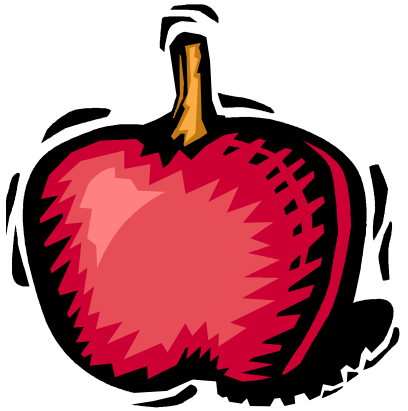
"To explain failure, do not try to find where people (simply) went wrong. Instead, find how people's **assessments and actions made sense at the time**, given the circumstances that surrounded them."

— Sidney Dekker



The 'Bad Apple' Theory

- Complex systems would be fine, if not for the erratic behavior of unreliable people.
- People cause accidents — they are dominant in over two-thirds of them.
- Failures are introduced into the system only through the inherent unreliability of people.



"Local Rationality" (What's really going on!)

- People in safety-critical jobs are **motivated to stay alive** and keep their co-workers safe.
- They **do not** go out of their way to hazard themselves, their colleagues, the public, or the environment.
- They **do what is reasonable** given their point of view, focus, knowledge, objectives, and the objectives of their organization.

Reacting to Failure

- "How could they not have noticed?"
- "How could they not have known?"

- Our reaction to failure tends to make us believe that human error was the cause!

Why do we react that way?

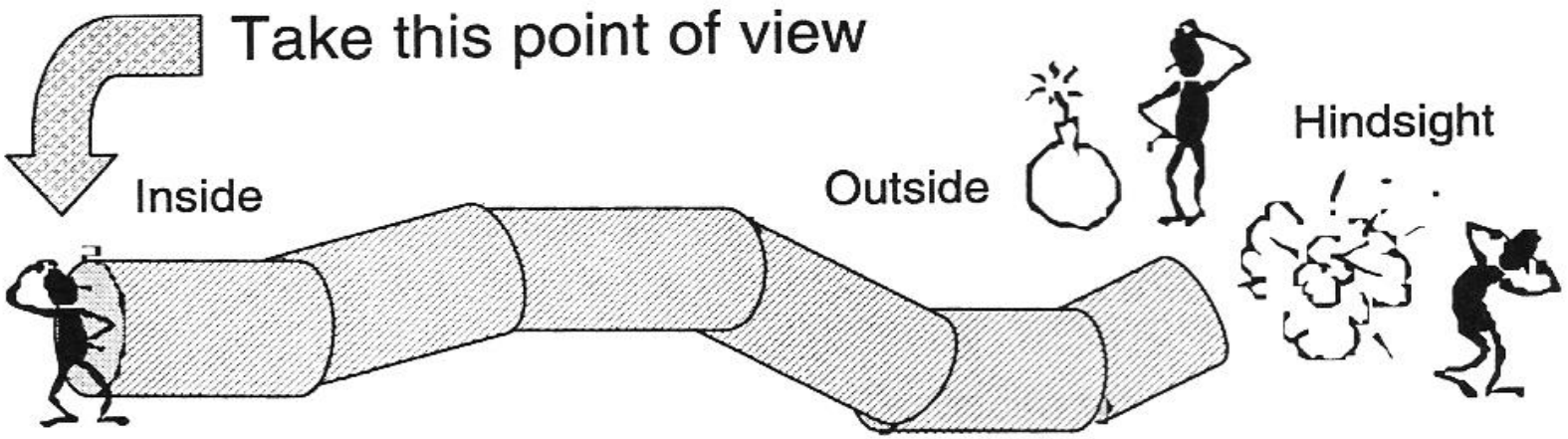
Our reaction is driven by normal biases.

- Retrospective
- Proximity
- Counterfactual
- Judgmental

Effort will be required to counteract this bias!

Retrospective = Hindsight

- You already know the outcome.
- ~ Unlimited access to ‘ground truth’.
- Which cues and indications were ‘critical’?
- What actions could have prevented the outcome?

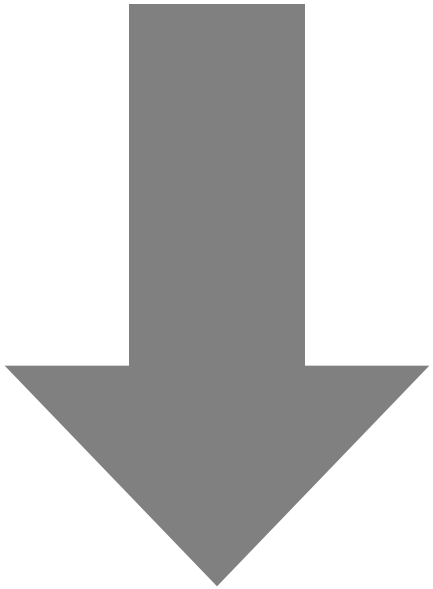


Proximity

Looking for errors at the Blunt End is counter-intuitive — **It can undermine belief in the safety of the system!**

Blunt End

(Latent Errors)

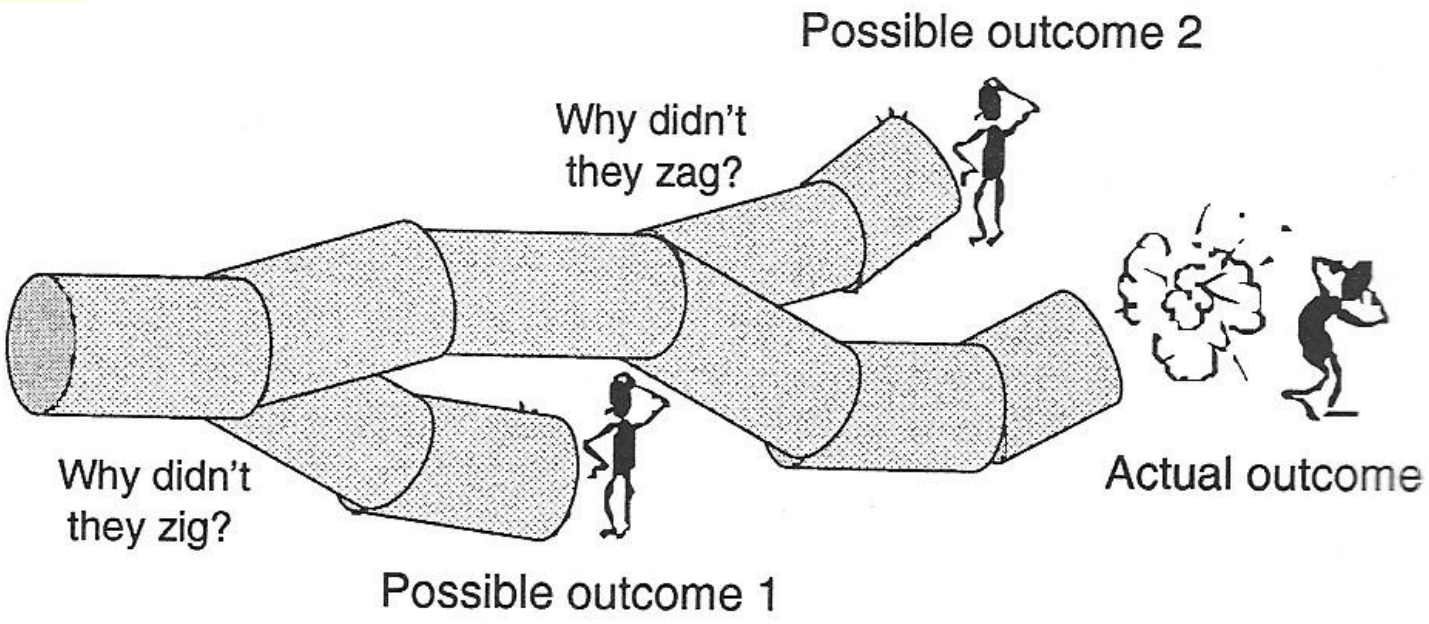


Sharp End

(Active Errors)

Counterfactual (If only…)

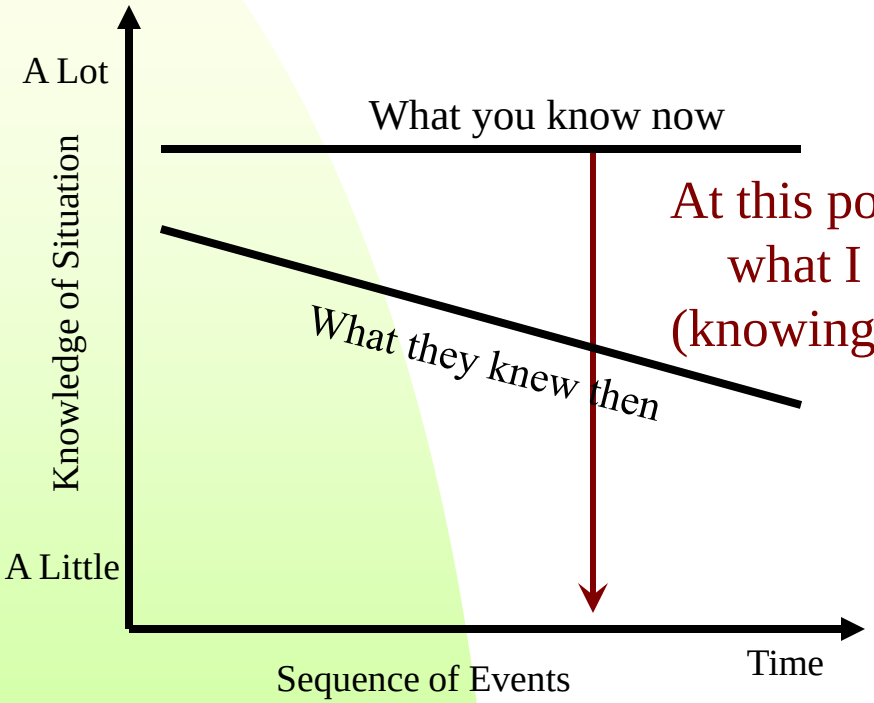
Why did they zig when they could have/should have zagged?



Stressing what was **not done** explains nothing about what did happen and why.

Critical points are much clearer **looking back**.

Judgmental



At this point they failed to do what I would have done (knowing what I know now)!

Saying people 'failed' to do the right thing (in hindsight) judges them to a standard that may only be achieved with broader knowledge.

You Can Avoid Hindsight Bias

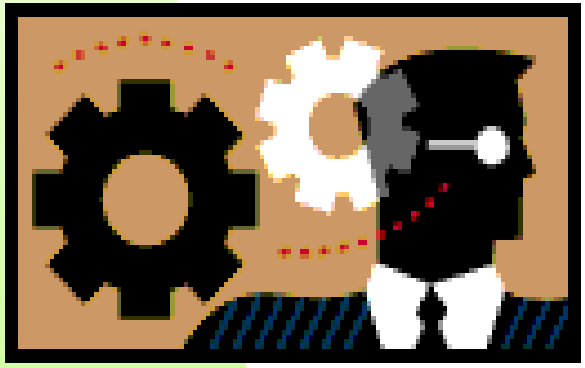
Keep the data in context:

- Put yourself into the shoes of people whose behavior you are trying to understand.
- Strictly consider what workers knew and understood *at the time*.
- You need to understand why it made sense to the worker to do what he or she did.
- To understand the error — no hindsight, no judgmental language, no counterfactuals

Contrasting Notions about the Causes of Events

NUCLEAR EXECUTIVE LEADERSHIP TRAINING

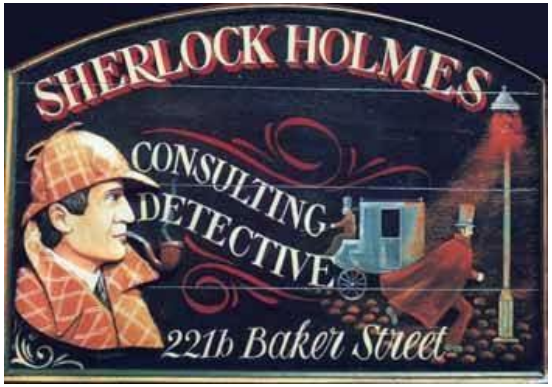
There is an ‘easy button’ for identifying causes of events.



Identifying the real causal factors is painstaking work!

What is the Cause?

- **Cause is not 'found', it is 'constructed'!**
- **It depends on:**
  - Where you look!
  - What you look for!
  - Who you talk to!
  - Your experience!
  - Who you work for!
- **Differing Views**:
  - Comair Flight 5191



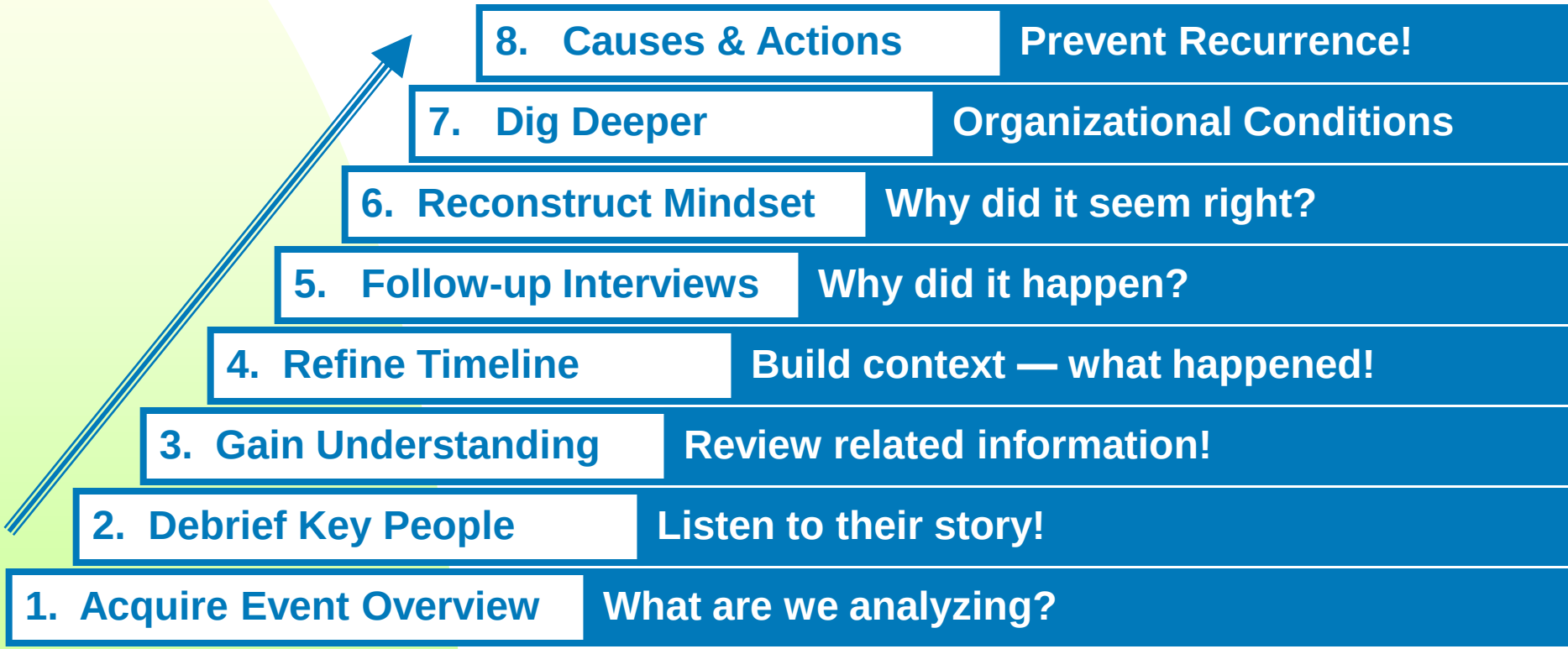
4-Potential Levels of Failure

Active Failures	Initiating Actions
Latent Failures	Error Precursors
Latent Failures	Flawed Defenses
Latent Failures	Latent Organizational Conditions

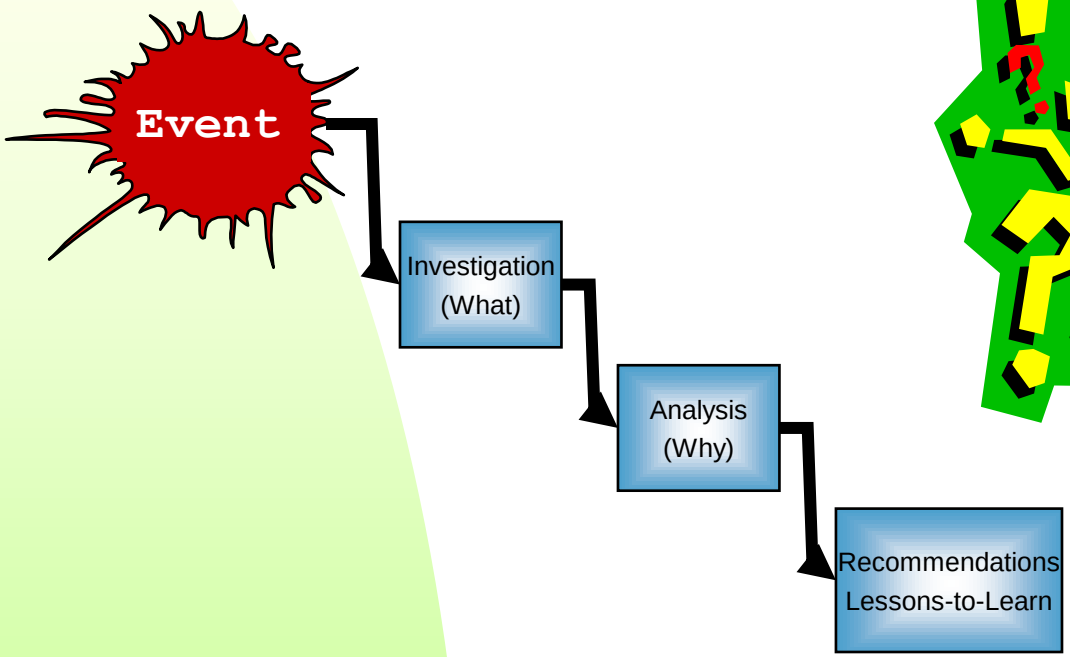
Event Analysis Tools

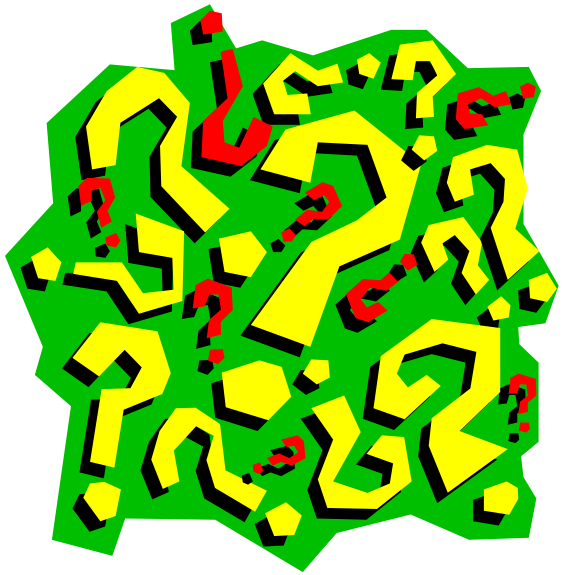
Initiating Action(s)	Interview Questions, Event Timeline
Error Precursors	Error Precursor List
Flawed Defenses	Defenses List, Unsafe Supervisory Practices List
Organizational Conditions	Latent Conditions List

HP Event Analysis Process



Questions? Feedback!

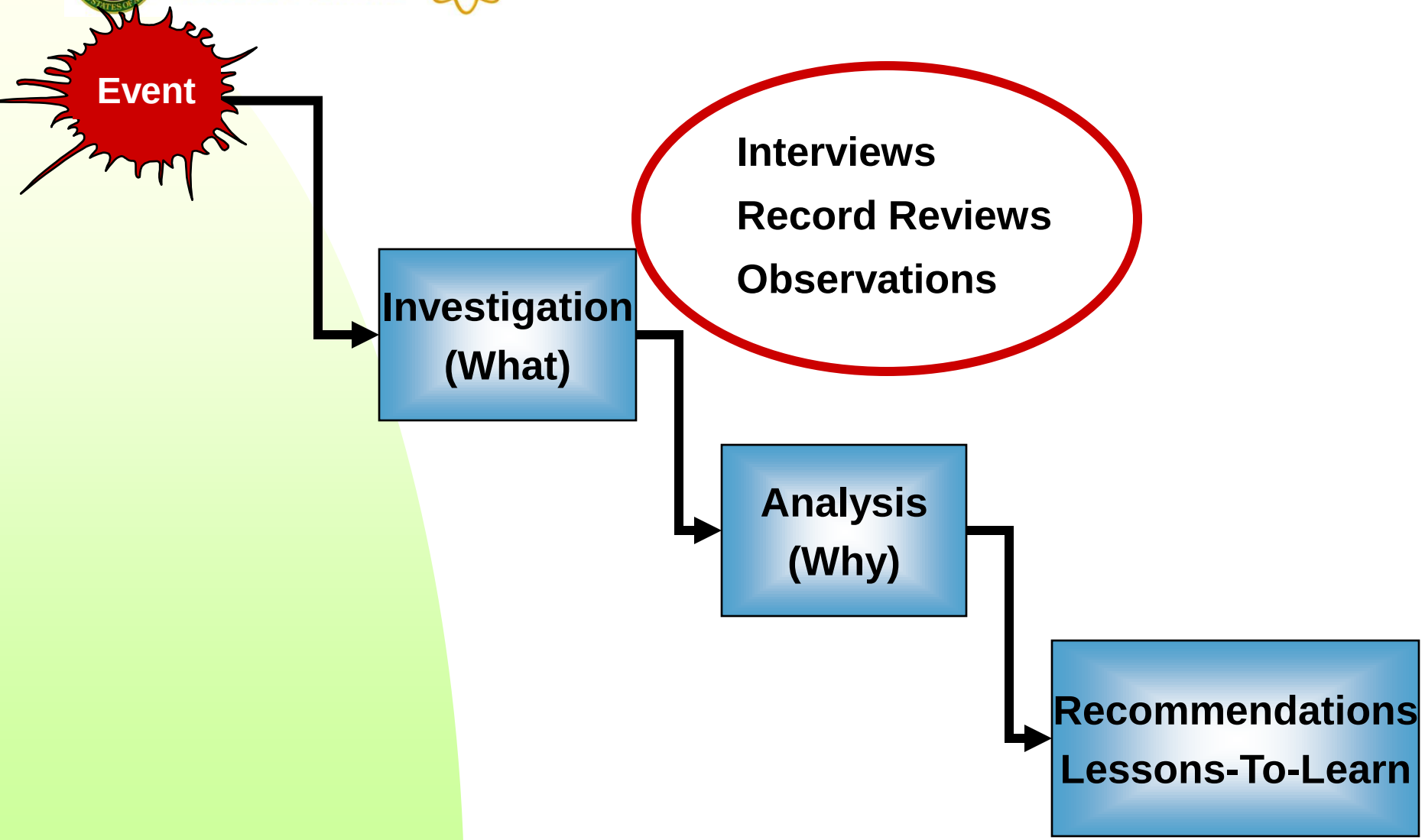




Topic 2: What Happened?

"The Investigation Phase"

Basic EA Flow



Activities in the Investigation Phase

- Conduct Debriefs.
- Start the event Timeline.
- Collect, assemble, and assess data.
- Expand the Timeline.
- Conduct Follow-Up Interviews.
- Complete the Timeline (Part 1).

Goal: Provide you with the skills to conduct the Investigation Phase activities.

“Seek first to understand!”

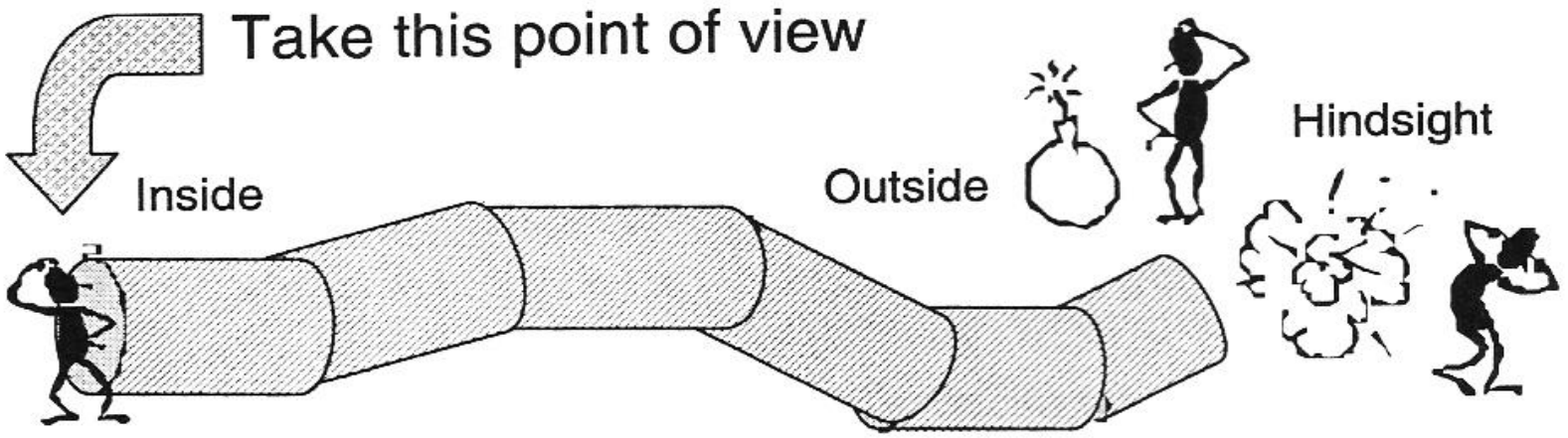
— Steven Covey, Habit 5

The purpose of the **Debrief** is to gain insight into **what happened** and **why** from the perspective of the people who were involved in or observed the event.

Why do a Debrief?

NUCLEAR EXECUTIVE LEADERSHIP TRAINING

Investigators need to know how the situation looked to the people from inside of the tunnel at each juncture.



- Sidney Dekker's Field Guide

HP-Based Debrief

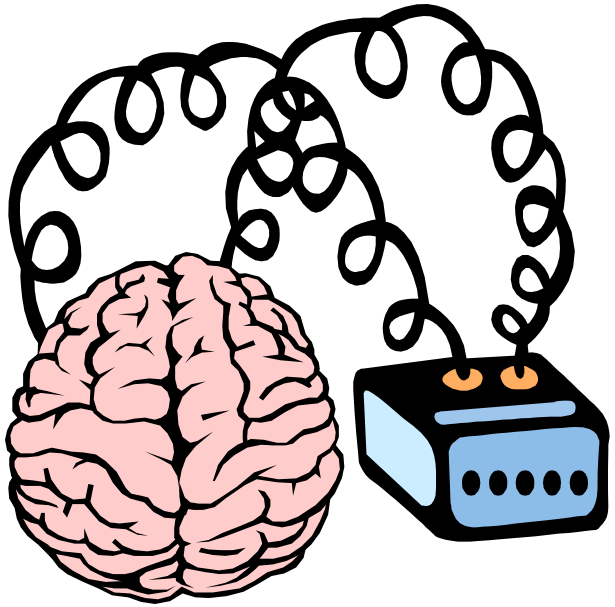
- Start your investigation with the Debriefs
  - before your biases develop, and
  - while interviewees recollections are fresh.
- Let each interviewee tell their story.
- Stay neutral and be objective throughout.
- **Remember** — You are interviewing, not interrogating!

Human Nature in Debriefs and Interviews

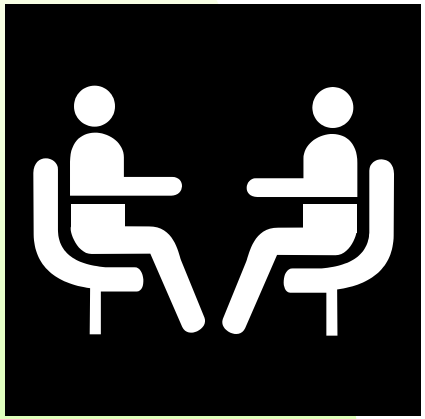
NUCLEAR EXECUTIVE LEADERSHIP TRAINING

Warning!

- Memory is not precise — it is not a video recording.
- Memory tends to order and structure events more than they actually were.
- Recollections diminish with time.
- Bad experiences can be modified or lost.



Elements of the Debrief



- Opening
- Questioning Process
- Active Listening
- Learn to Be Quiet
- Closing

Debrief Opening

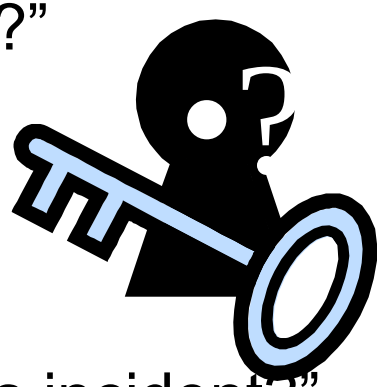
- Introduce yourself and ask interviewee to introduce him/herself.
- Put the interviewee at ease.
- Explain the purpose of the interview.
- Explain note taking and how the information will be used.
- Answer questions about the interview and the causal analysis process.

Guiding the Debrief

- Ask them to explain their involvement. "Would you please tell me about…?"
- Ask "And then what happened?" etc. etc.
- Ask "What else was going on?"
- Ask for 'clarification' of statements that you do not understand.
- 'Confirm' your understanding by stating back what the person said.
- Identify key words/remarks to follow up on.
- Key on words like "stressed" and "in a hurry".

Key Questions

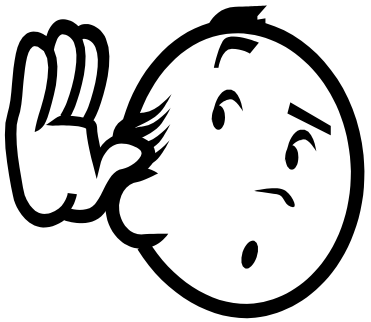
- "What was talked about at the pre-job brief?"
- "How would you have performed the task, if it had been up to you alone?"
- "Is it always done that way?"
- "What could have been done to prevent this incident?"



With feelings and perceptions —
Capture exact quotes as to "why" they feel that way.

Active Listening

- Active listening intentionally focuses on who you are listening to, whether in a group or one-on-one setting, in order to understand what he or she is saying.
- Maintain eye-contact with the speaker.
- As the listener, you should be able to repeat back, in your own words, what they have said (to their satisfaction).



- This does not mean you agree with what they are saying. But rather, you *understand* what they are saying.

Learn to Be Quiet

- Use open-ended questions and listen.
- Allow the interviewee to finish speaking.
- Don’t interrupt with another question until the first question is answered and you understand what was said.

Closing

- Summarize what you have been told.
- Ask - “Is there anything else I need to know?”
- Encourage interviewees to contact you with additional information/concerns.
- Thank the individual for his or her time.
- Remind the individual that a follow-up interview may be conducted.

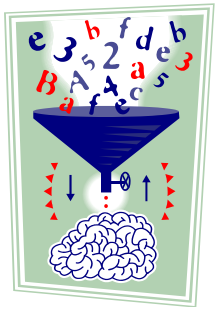
Air Florida Flight 90 Crash

Air Florida Flight 90 Crash

Classroom Demo

Observe the debrief of the surviving crew member of Air Florida Flight 90

What do we know?
(And what do we do with it?)



Organizing Event Information -

Developing the Timeline

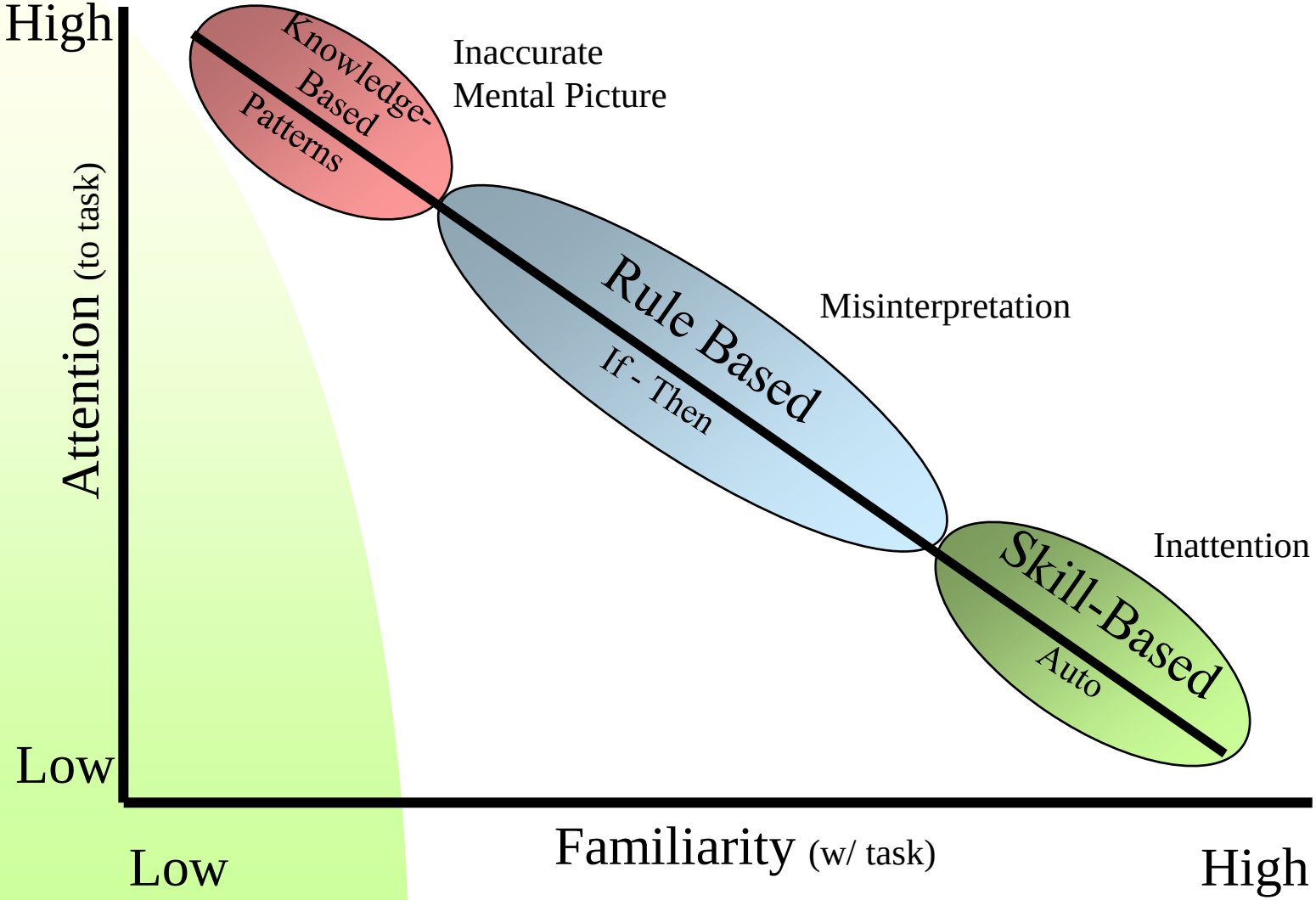
Date/ Time	Actions/ Inactions	Data Available	Issues/ Problems	Mindset	PM
1/13/07 13:15	Passengers commence boarding	24º, Snow Falling	Snow buildup on runway and plane		

Mindset

- Tendency to “see” only what the mind is *tuned* to see (intention)
- Preconceived idea
- Information that does fit a mind-set may not be noticed and vice versa;
- May miss information that is not expected or may see something that is not really there;
- Contributes to difficulty in detecting one's own error(s) (aka: *mental inertia*, “groupthink”, or “paradigm”)

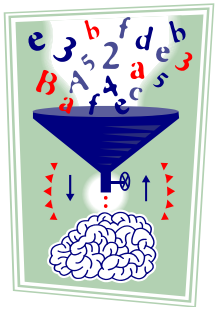
Goals + Knowledge → Focus

Performance Modes



•Source: James Reason. *Managing the Risks of Organizational Accidents*, 1998.

What do we know?
(And what do we do with it?)



Organizing Event Information

Developing the Timeline

Date/ Time	Actions/ Inactions	Data Available	Issues/ Problems	Mindset	PM
1/13/07 13:15	Passengers commence boarding	24º, Snow Falling	Snow buildup on runway and plane		

Air Florida Flight 90 Timeline

Date	WHAT				
Time	Actions/Inactions	Data Available	Issues/Problems	Mindset	PM
01/13/82					
1315	Passengers begin loading onto the plane				
1330	All passengers are on board	Heavy snow falls - 24° at the airport	Snow buildup on plane & runway		
1340	Airport is closed to remove snow from the runway				
1415	Flight 90 is scheduled for departure				
	The captain requests deicing of the aircraft				R
		Captain learns the runway will be closed longer than expected and there are 11 other aircraft with priorty ahead of his flight		Goal is to get the 737 in flight as soon as possible and not slip the schedule too much	
	The Captain halts de-icing process because of the forced delay.			Anxiety over missing scheduled takeoff	K
				Change in routine or 'process change' -- bad weather focuses crew's attention to related problems	

What Now?

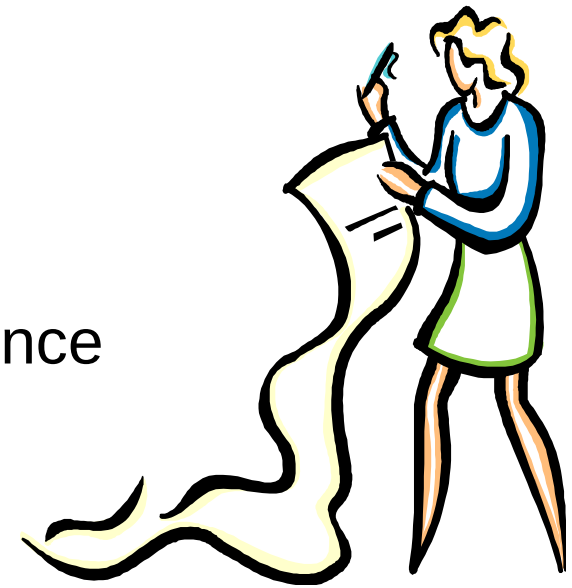
- What do we know?
- How will we get additional data? (The “Rest of the Story”)

Data Methods

- Review the workplace and equipment (job site conditions).
- Identify procedures, logs, printouts, and other materials the participants used.
- Conduct a fact finding meeting.
- Obtain statements from third parties.
- Review historical sources.

Data Sources

- System Descriptions/Safety Basis
- Operating/Maintenance Procedures
- Training Records
- Past Incidents and Operating Experience
- Regulatory Requirements
- Industry Standards and Guidance
- Etc.



The interview is the
single most powerful tool
in conducting Event Analysis!

Interview Techniques

- Prepare questions in advance
- Avoid leading questions.
- Remove personal bias.
- Don’t “point-the-finger”.
- Use short questions and plain English.
- Interview in a quiet, private location.
- Limit the number of people at the interview.
- Is union representation/management presence required/allowed?

At Each Juncture in the Timeline

Your objective is to find out:

- Which **cues** were observed/recognized.
- What items they expected, but **did not** see.
- What **knowledge** was used to deal with the situation?
- Did the individual have any **experience** with similar situations that was useful in dealing with this one?

At Each Juncture in the Timeline

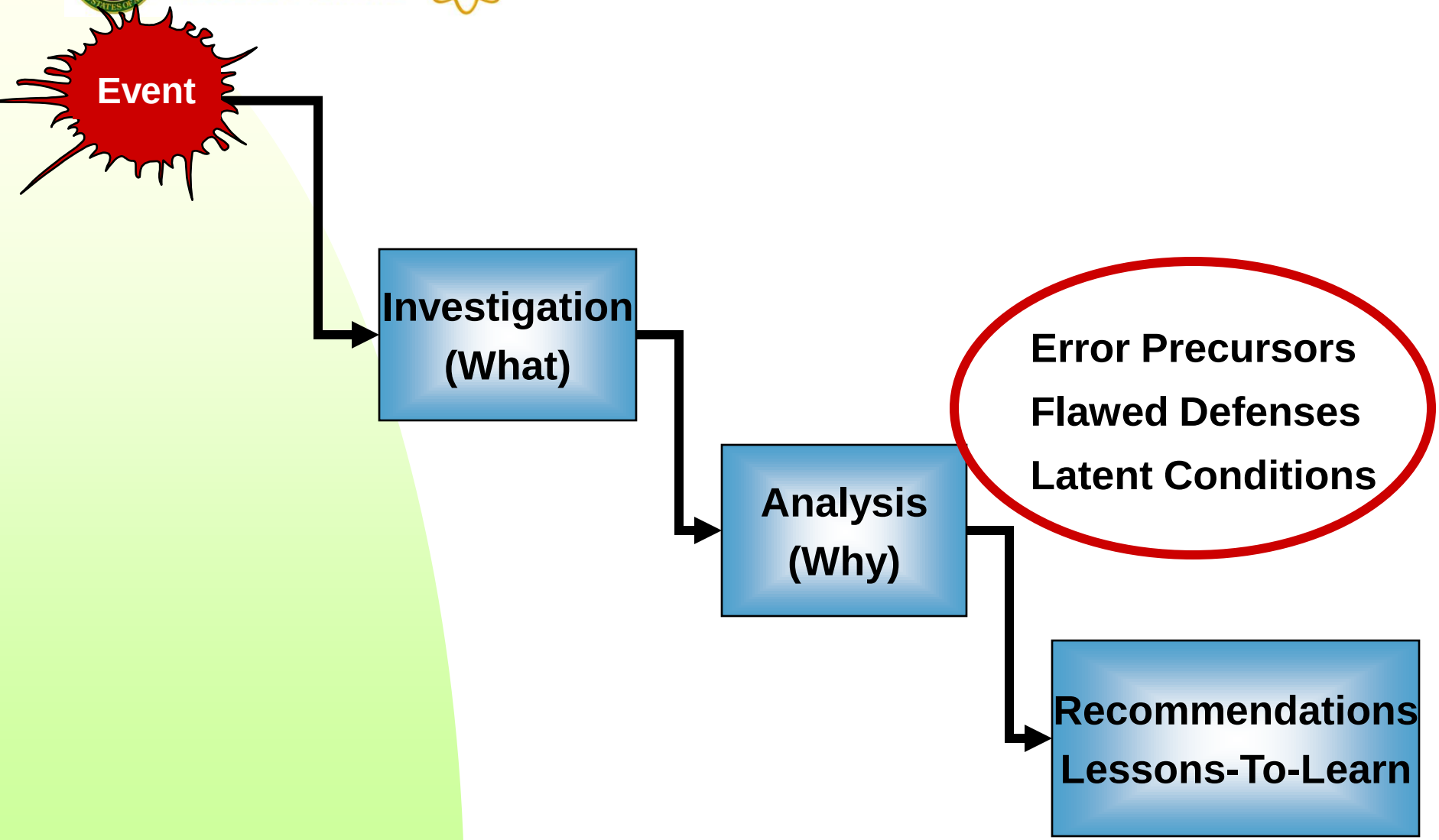
NUCLEAR EXECUTIVE LEADERSHIP TRAINING

- What **expectations** did they have about how things were going to develop?
- What **options** did they think they had to influence the course of events?
- How did **other influences** (operational or organizational) help determine how they interpreted the situation and how they acted?

Topic 3: Why Did It Happen?

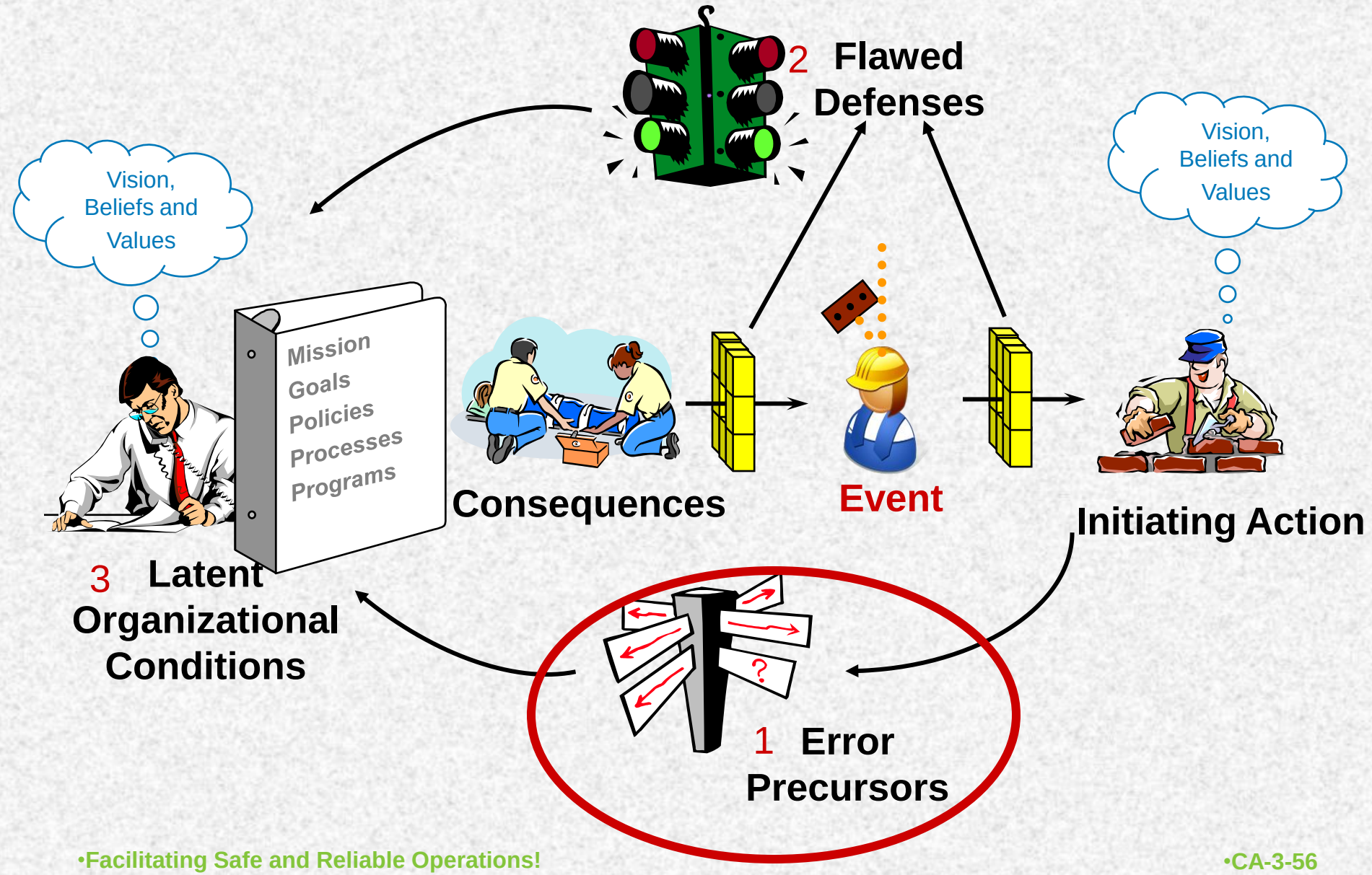
"The Analysis Phase"

Basic EA Flow



Analysis Tools

Anatomy of an Event



Organizing the Timeline

Create Chapters or Episodes

Date/ Time	Actions/ Inactions	Data Available	Issues/ Problems	Mindset	PM
1/13/07 13:15	Passengers commence boarding	24º, Snow Falling	Snow buildup on runway and plane		

Air Florida Flight 90 Episodes

NUCLEAR EXECUTIVE LEADERSHIP TRAINING

1) Snow Removal & De-Icing

Time	Actions/Inactions	Data Available	Issues/Problems	Mindset	PM
01/13/82					
1315	Passengers begin loading onto the plane				
1330	All passengers are on board	Heavy snow falls - 24" at the airport	Snow buildup on plane & runway		
1340	Airport is closed to remove snow from the runway				
1415	Flight 90 is scheduled for departure				
	The captain requests deicing of the aircraft				R
		Captain learns the runway will be closed longer than expected and there are 11 other aircraft with priority ahead of his flight		Goal is to get the 737 in flight as soon as possible and not slip the schedule too much	
	The Captain halts de-icing process because of the forced delay.			Anxiety over missing scheduled takeoff	
				Change in routine or 'process change' -- bad weather focuses crew's attention to related problems	
			Weather conditions presented a change--departure from routine		
1500	Captain requests de-icing process to resume	Heavy wet snow continues to fall			
			Left side of plane is de-iced but anti-icing overspray was not applied		
	A ground crew shift change takes place			Priority - to get the plane de-iced as it is a prerequisite to being allowed to take off	

Date	WHAT				
Time	Actions/Inactions	Data Available	Issues/Problems	Mindset	PM
	The operator de-iced the right side of the plane, then oversprayed right side of plane with the wrong anti-ice solution. 100% anti-freeze is the proper formula. Formula used was only 35% anti-freeze. Left side of plane was not anti-iced	Weather conditions continue to deteriorate	Confusing, incorrect, instruction or direction -- related anti-icing formulas.		
	The spray nozzle on de-ice truck had been replaced with wrong nozzle. The crew may have actually been icing the plane vise de-icing it.		Inadequate or inappropriate equipment. Unexpected equipment conditions		
	No protective engine covers or plugs are used during the de-icing process		Lack of sufficient equipment	Crew is in a hurry. As weather worsened the prospect of further delays become worrisome. Time is working against them.	

2) Gate Departure and Pre-Flight

1525	Flight 90 receives permission to push away from its gate	De-icing completed about 10 minutes prior			
	Push-back vehicle without chains tries to move the plane		the push-back vehicle did not have sufficient traction to move the plane		
	The flight crew recommends deploying the thrust reversers to move the plane	Crew knows the tug has failed to move the plane		The crew is under increasing time pressure to get the plane off the ground	
		Vehicle operator told the crew that policy prohibited the use of thrust reversers at the gate			

Date	WHAT				
Time	Actions/Inactions	Data Available	Issues/Problems	Mindset	PM
	The crew starts the engines and deploys the thrust reversers.	Airport policy forbits the use of thrust reverser at any gate		Crew is in a hurry. They do not want to wait. They see that the ground crew attempts to move the aircraft have failed	R
	Thrust reversers did not move the plane as expected	Crew had an inaccurate risk perceptions associed with using thrust reversers at the gate	Thrust reversers blew snow and slush debris into the engines		
	Ground crew brings up another tug with chains that pushes back the plane				
	Flight crew performs an after-start check preparing to taxi to their runway				S
	The interior anti-ice system switch is not turned on as it should have been per the checklist requirement	Boeing operations manual for 737s requires the use of engine anti-ice system in these conditions	complacency or distraction? They forget to turn on the innternal anti-ice system		S
		Weather continues to deteriorate			
		Flight crew is anxious about icing conditions			

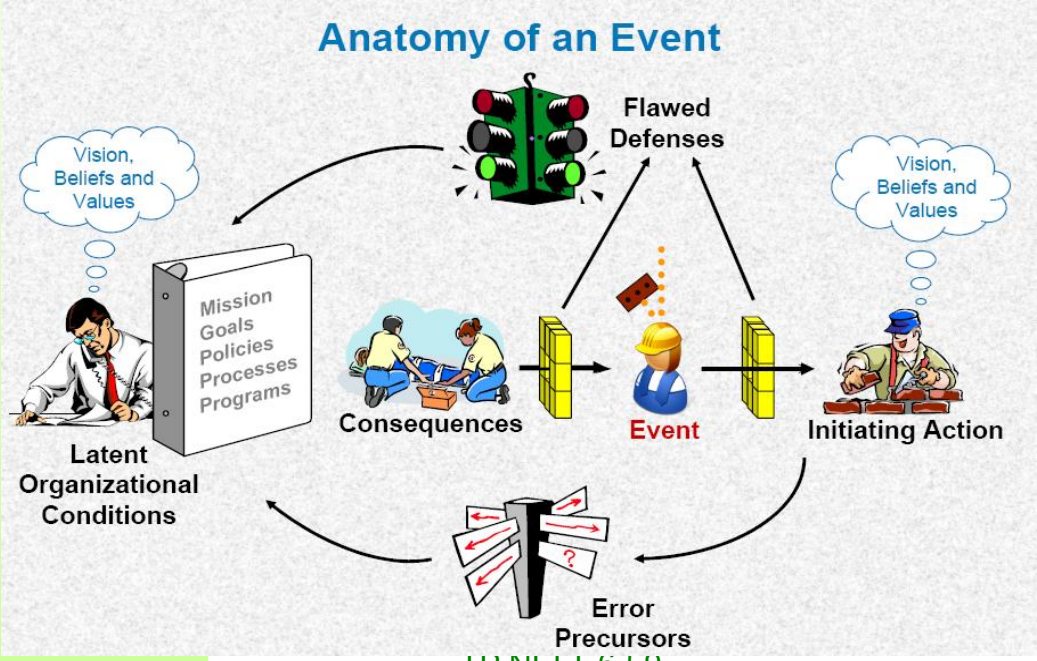
3) Take-Off

Date	WHAT				
Time	Actions/Inactions	Data Available	Issues/Problems	Mindset	PM
1556	The first officer tells the captain there were differences in engine performance indicators between the two engines		Cockpit crew does not communicate effectively on the engine EPR indications, corrective actions or possible consequences		
	Snow builds up on wing surfaces during the 49 minute period between de-icing and take off			Returning to have the plane de-iced would mean loosing their place in line for takeoff and taking off --getting out of this weather is their mindset	
1557	First Officer calls Captain's attention to anomalous engine readings 4 more times in last few moments	EPR readings between the 2 engines were not as expected			
1559	The Captain rotates the aircraft off the runway	Captain knows he can abort the takeoff. Operating procedures and FFA regulations prohibit takeoff with snow adhering to wings or control surfaces.		Captain has an inaccurate perception of risk-- rotating the plane off the runway with inaccurate EPR readings in poor weather and snow on wings	R
1600	Plane experiences an unusual pitch-up of the nose shortly after the plane rotates off the runway	Crew had only limited experience in jet transport winter operations	Ice on the leading edges of the wings		
		Warning is sounded of an impending stall			

Date	WHAT				
Time	Actions/Inactions	Data Available	Issues/Problems	Mindset	PM
	The aircraft looses attitude	Engines EPR readings showed full thrust at limits - 2.04. Actually thrust was 1.70, only about 70% of full thrust			
	Captain fails to increase engine thrust.		Captain may have lacked knowledge of how to correct for nose up attitude		K
1601	The plane hits the 14th Street bridge and plunges into the Potomic River in about 20 feet of water.				

WHY — The Timeline Continued

WHY (Drivers/Causes)		
Error Precursors	**Flawed Defenses**	**Latent Conditions**



Air Florida Flight 90 Episode-1

NUCLEAR EXECUTIVE LEADERSHIP TRAINING

1) **Snow Removal & De-Icing**

1 2 3

Date / Time	WHAT: Actions/Inactions	Data Available	Issues/Problems	Mindset	PM	WHY (Drivers/Causes): Error Precursors	Flawed Defenses	Latent Conditions
01/13/82								
1315	Passengers begin loading onto the plane							
1330	All passengers are on board	Heavy snow falls - 24" at the airport	Snow buildup on plane & runway					
1340	Airport is closed to remove snow from the runway					Adverse Climate (W), Unfamiliarity (I)		Gaps in training
1415	Flight 90 is scheduled for departure							
	The captain requests deicing of the aircraft				R			
		Captain learns the runway will be closed longer than expected and there are 11 other aircraft with priority ahead of his flight		Goal is to get the 737 in flight as soon as possible and not slip the schedule too much		Departure from Routine (W)		
	The Captain halts de-icing process because of the forced delay.			Anxiety over missing scheduled takeoff	K	Delays (T)		Emphasis on Schedule Adherence
				Change in routine or 'process change' -- bad weather focuses crew's attention to related problems				
			Weather conditions presented a change-- departure from routine					
1500	Captain requests de-icing process to resume	Heavy wet snow continues to fall			K			
			Left side of plane is de-iced but anti-icing overspray was not applied					
	A ground crew shift change takes place			Priority - to get the plane de-iced as it is a prerequisite to being allowed to take off		Shift Change (W)	Flawed anti-icing application: Poor turnover	Weak safety programs

Identify Error-Precursors

T-W-I-N:

- **T**ask Demands
- **W**ork Environment
- **I**ndividual Capabilities
- Human **N**ature

Task Demands	Individual Capabilities
• Time pressure (in a hurry)	• Unfamiliarity w/task / First time
• High Workload (memory requirements)	• Lack of knowledge (mental model)
• Simultaneous, multiple tasks	• New technique not used before
• Repetitive actions, monotonous	• Imprecise communication habits
• Irrecoverable acts	• Lack of proficiency / Inexperience
• Interpretation requirements	• Indistinct problem-solving skills
• Unclear goals, roles, & responsibilities	• "Hazardous" attitude for critical task
• Lack of or unclear standards	• Illness / Fatigue
Work Environment	**Human Nature**
• Distractions / Interruptions	• Stress (limits attention)
• Changes / Departures from routine	• Habit patterns
• Confusing displays or controls	• Assumptions (inaccurate mental picture)
• Workarounds / OOS instruments	• Complacency / Overconfidence
• Hidden system response	• Mindset ("tuned" to see)
• Unexpected equipment conditions	• Inaccurate risk perception (Pollyanna)
• Lack of alternative indication	• Mental shortcuts (biases)
• Personality conflicts	• Limited short-term memory

Air Florida Flight 90 – Error Precursors

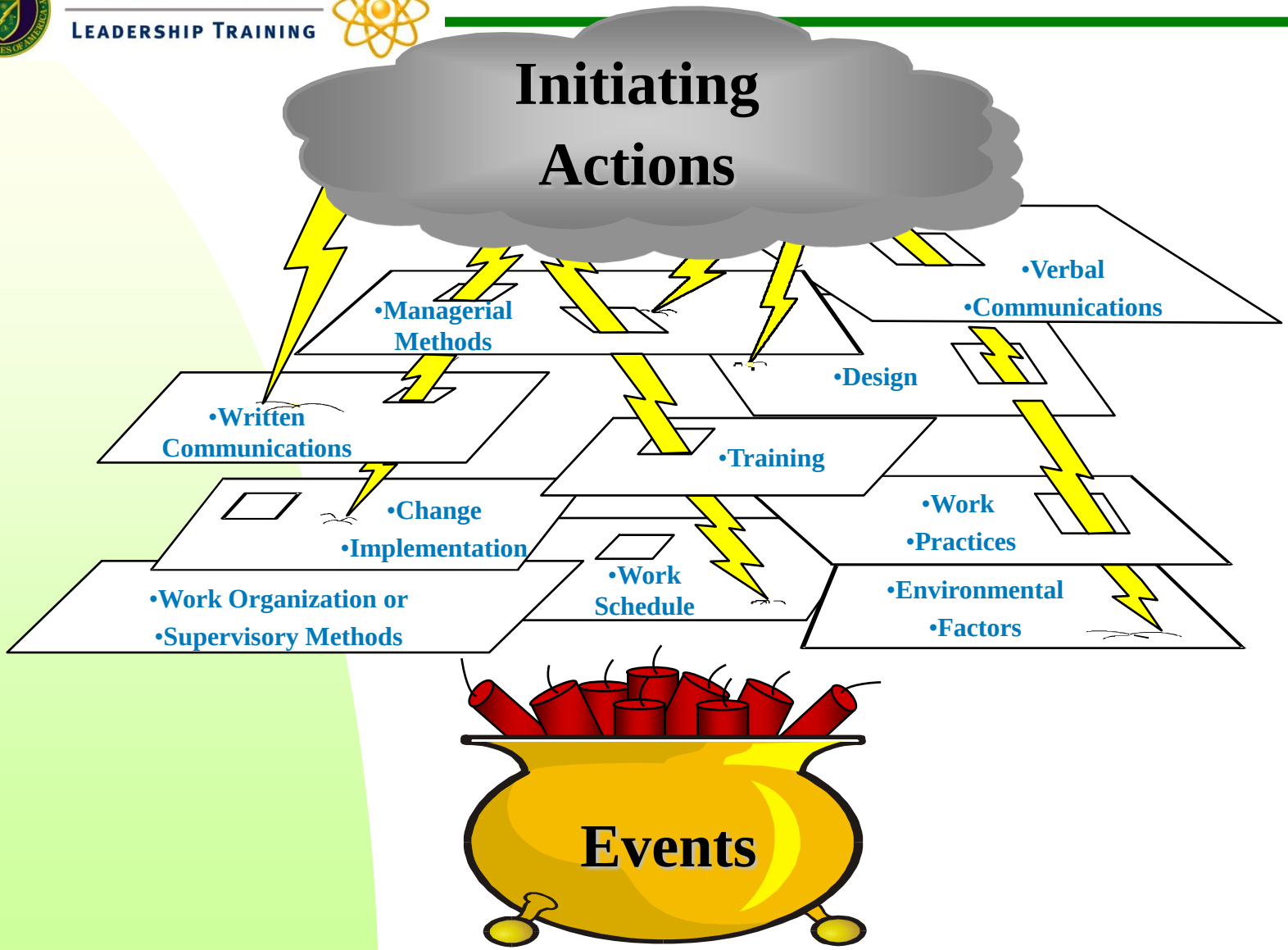
NUCLEAR EXECUTIVE LEADERSHIP TRAINING

- Adverse Climate (W)
- Unfamiliarity (I)
- Departure from Routine (W)
- Inaccurate Risk Perception (N)
- Assumptions (N)
- Shift Change (W)
- Delays (T)

The Aftermaths of Flawed Defenses

Defense-in-Depth is Diverse and Redundant!

NUCLEAR EXECUTIVE LEADERSHIP TRAINING




JOB-SITE CONDITIONS
WORKER BEHAVIOR
ORGANIZATIONAL FACTORS
PLANT RESULTS
Leadership
Equipment Ergonomics & Human Factors
Environmental Conditions
Work-arounds & Inconveniences
Fitness-for-Duty
Worker Knowledge, Skill, & Proficiency
Procedure / Work Package Quality
Equipment Labeling & Equipment Condition
Personal Motives
Morale
Lockout / Tagout
Tool Quality & Availability
Intolerance for Error Traps
Foreign Material Exclusion
Values & Beliefs
RWPs
Uneasy Attitude
Roles & Responsibilities
Turnover
Clearance Walkdown
Prejob Briefing
Just-in-time Operating Experience
Task Preview
Flagging
Housekeeping
Questioning Attitude
Critical Parameters
Effective Communication
Procedure Use & Adherence
Conservative Decision-Making
Management Monitoring
Rigor
Self-Checking
Place-Keeping
Problem-solving Methodology
Concurrent Verification
Supervision
Peer-Checking
Job-site Review
Recognizing Error Traps
Team Skills
Stop When Unsure
Situation Awareness
Coaching
Respect for Others
Walkdowns
HP Surveys
Task Qualification
Task Assignment
Performance Feedback
High Standards
Motivation
Healthy Relationships
Reinforcement
Courage & Integrity
Proper Reactions
QC Hold Points
Independent Verification
Forcing Functions
Interlocks
Personal Protective Equipment
Foreign Material Exclusions
Alarms
Handoffs
Training
Procedure Revisions
Rewards & Reinforcement
Meetings
Compatible Goals & Priorities
Reviews & Approvals
Role Models
Safety Culture
Strategic HU Plans
Design & Configuration Control
Staffing
Op Ex
Work Mgmt
Simple / Effective Processes
Problem-Solving
Task Allocation
Clear Expectations
Self-Assessment
Accountability
Scheduling / Sequencing
Change Mgmt.
Benchmarking
Socialization
Labor Relations
Corrective Action Program
Communication Practices & Plan
Management Oversight
Trend Analysis
Compelling Vision
Sets Example
Open & Honest Communication
Postjob Review
Causal Analysis
Problem Reporting
Independent Oversight
Performance Indicators
Reactor Protection Systems
Equipment Reliability
Safeguards Equipment
Containment

Air Florida Flight 90 - Flawed Defenses

- **Flawed anti-icing application**: Poor turnover
- **Wrong anti-icing formula**: Flawed reviews, inadequate self-assessments
- **Wrong de-icing nozzle used**: Loss of design and configuration control, poor QA review process; Questionable tool quality and availability
- **Failure to use protective covers**: Inadequate equipment availability
- **Failure to do visual inspection of plane's exterior**: No equivalent job site review, lacking a questioning attitude, non-recognition of error traps

Organizational Influences

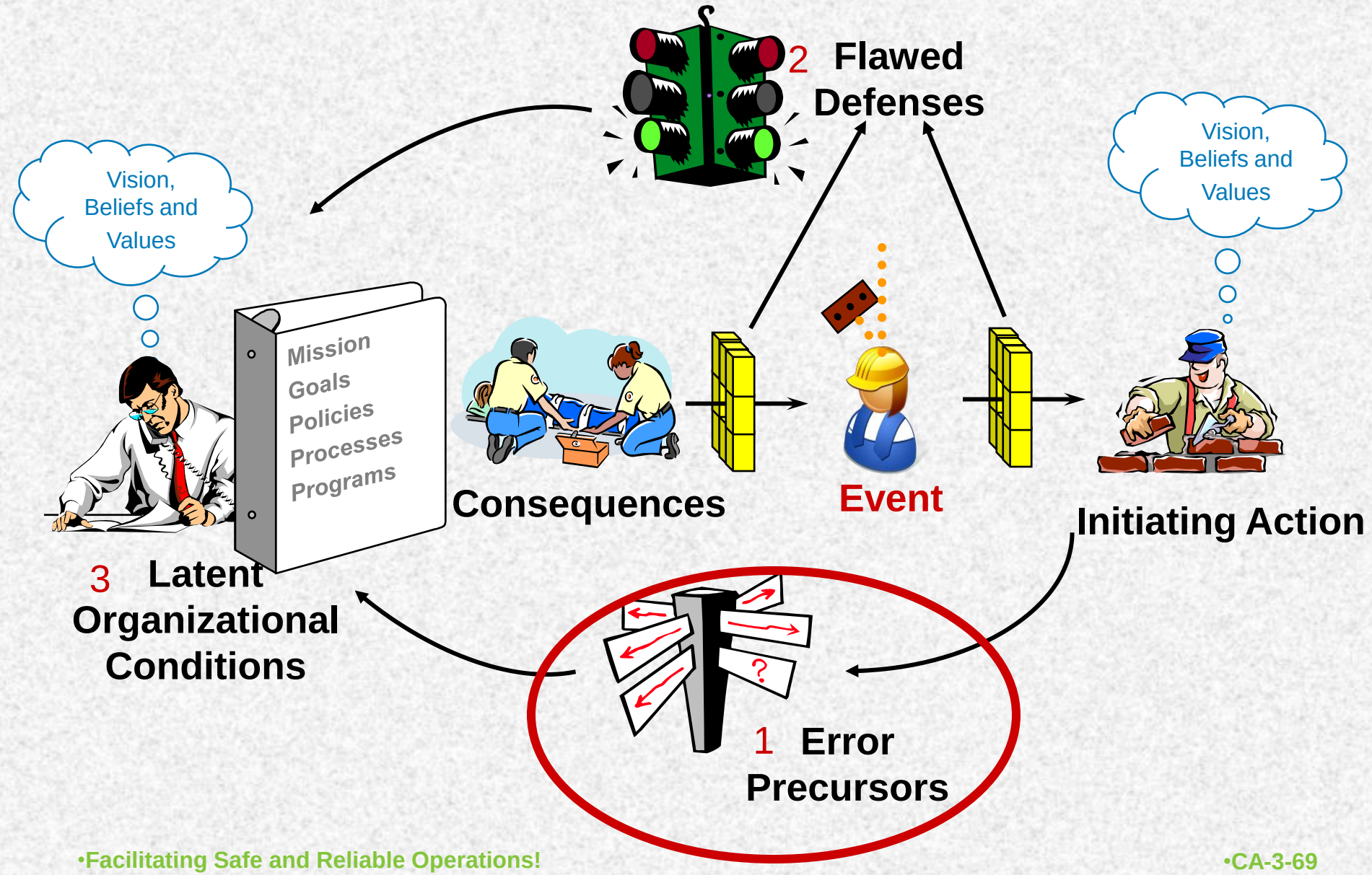
"Like pathogens, latent conditions may be present for many years before they combine with local circumstances and active failures to penetrate he system's many layers of defenses."

— Reason, 1997 p. 10

Air Florida Flight 90: Latent Organizational Conditions

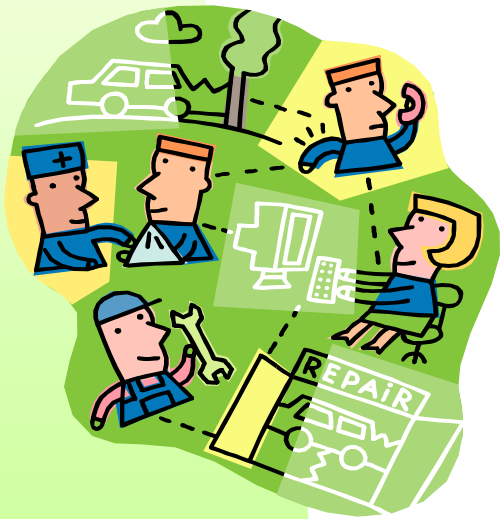
- Gaps in training
- Emphasis on Schedule Adherence
- Weak safety programs
- Deficient procedures or work instructions
- Inadequate parts, tools, and equipment
- Flawed risk assessment
- Weak organizational culture

Anatomy of an Event

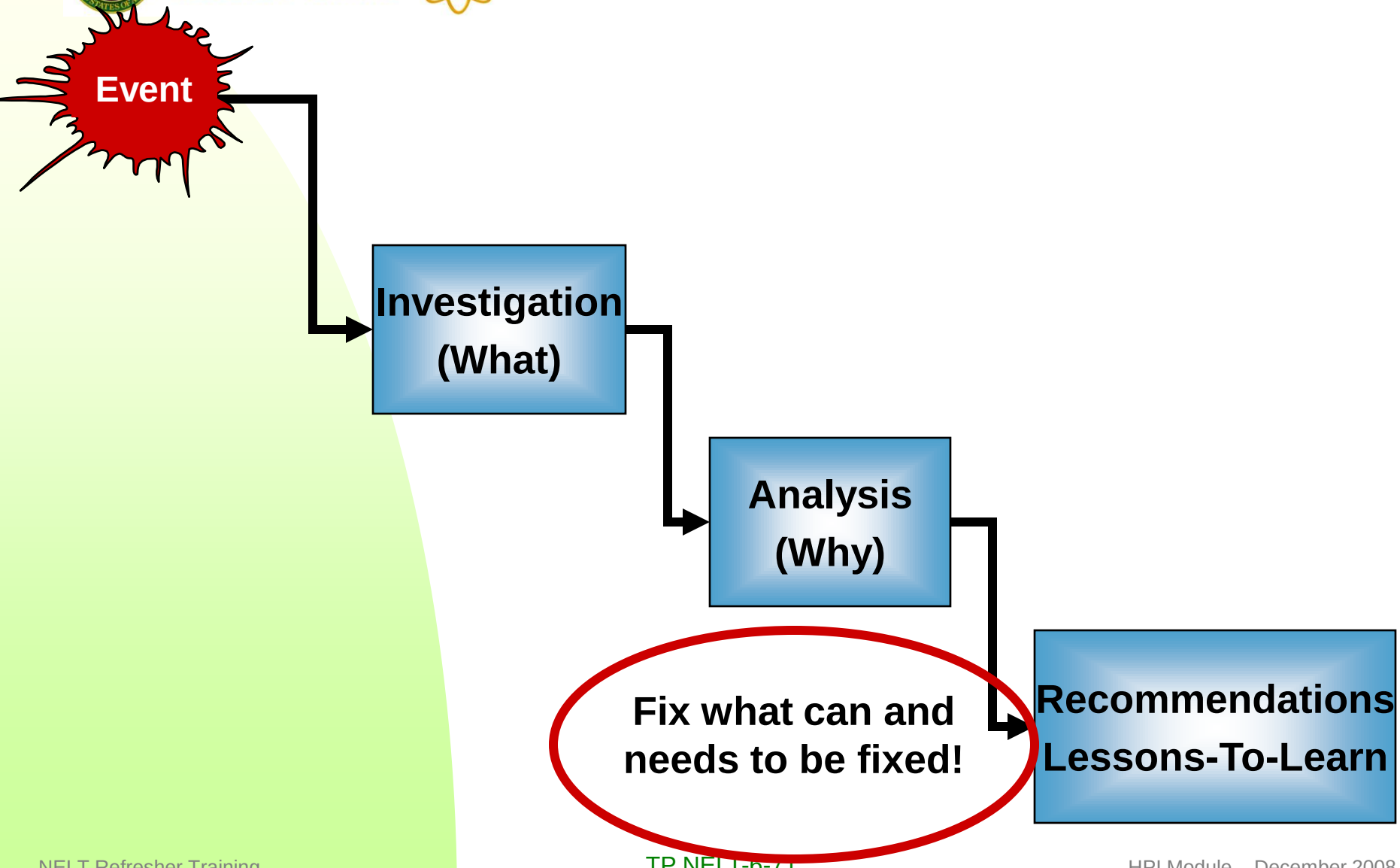


Topic 4: Preventing Recurrence!

"Recommendations and Lessons-to-Learn"



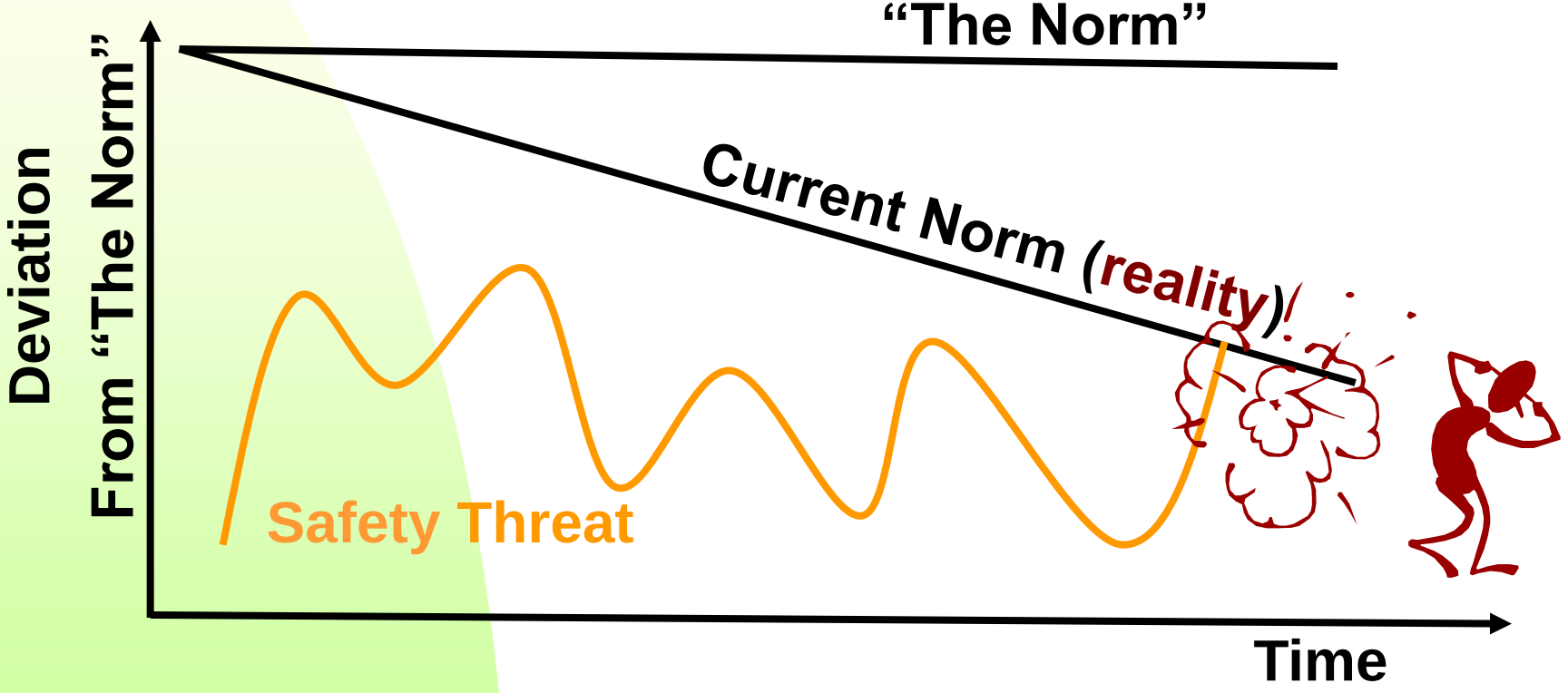
Basic EA Flow



Challenges

- Selecting the right causal factors
- Writing good recommendations
- Selling your recommendations

Events Come From 'Normal' Behavior



Why did they do that?

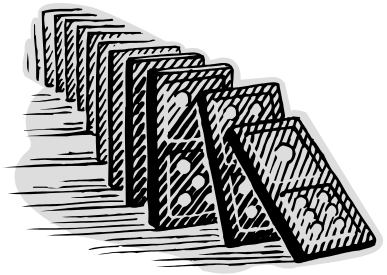
- People do what they have done before.
- People do what they see others do.
- People don't do what they can't.
- Behavior is a function of structure.
- Behavior is elicited by antecedents.
- Behavior is a function of consequence.
- Vicarious consequences work as well as personal ones.

Why did they do that?

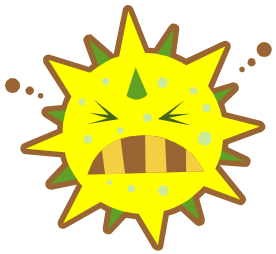
- Experience makes an antecedent out of an item.
- Reinforcement increases frequency.
- Reinforcement works until it saturates.
- Punishment decreases frequency.
- Punishment elicits only its avoidance.
- Null consequences are punishment for functional behavior.
- Null consequences are reinforcement for dysfunctional behavior.

Accident Models

Sequence of Events



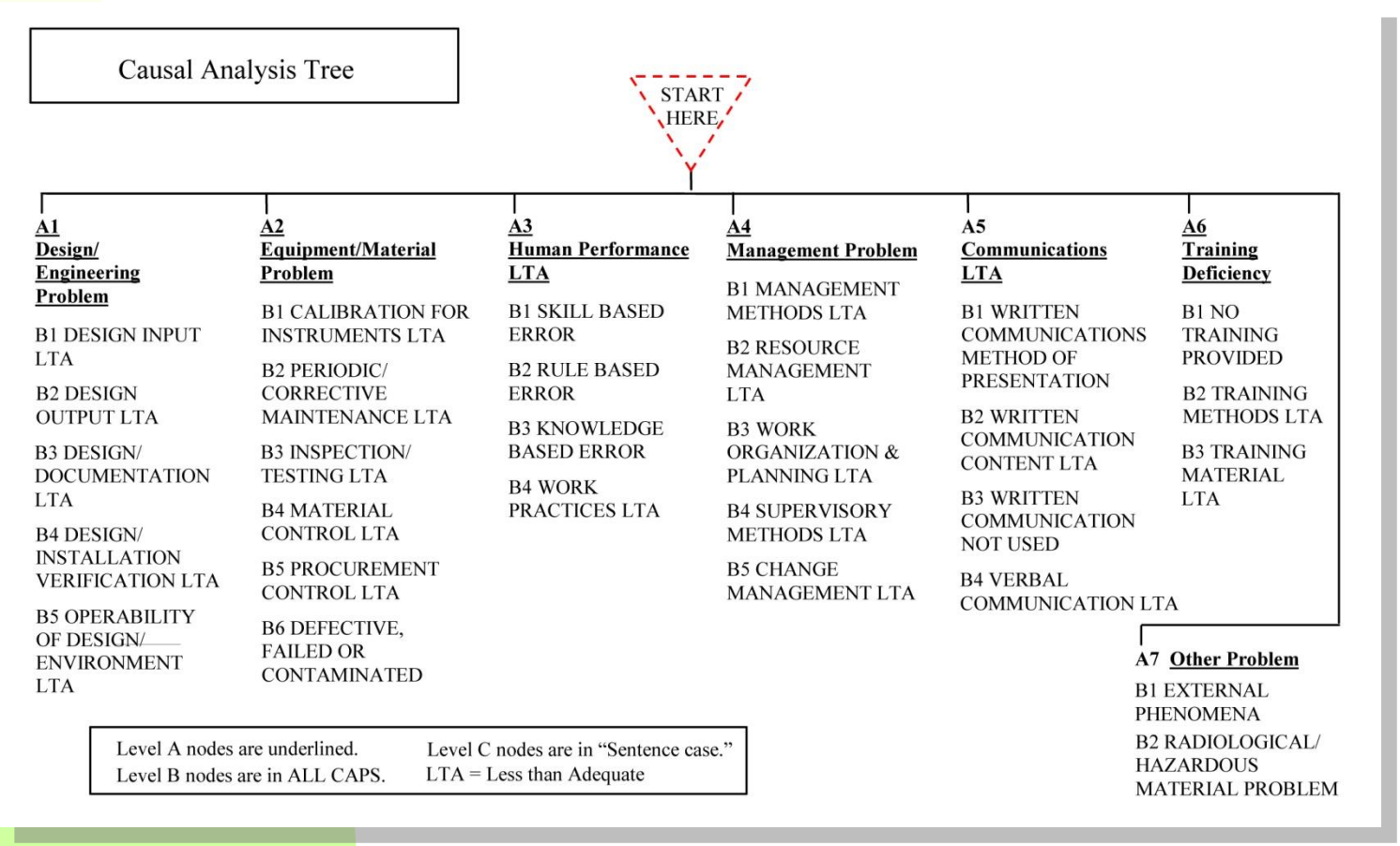
Epidemiological



Systemic

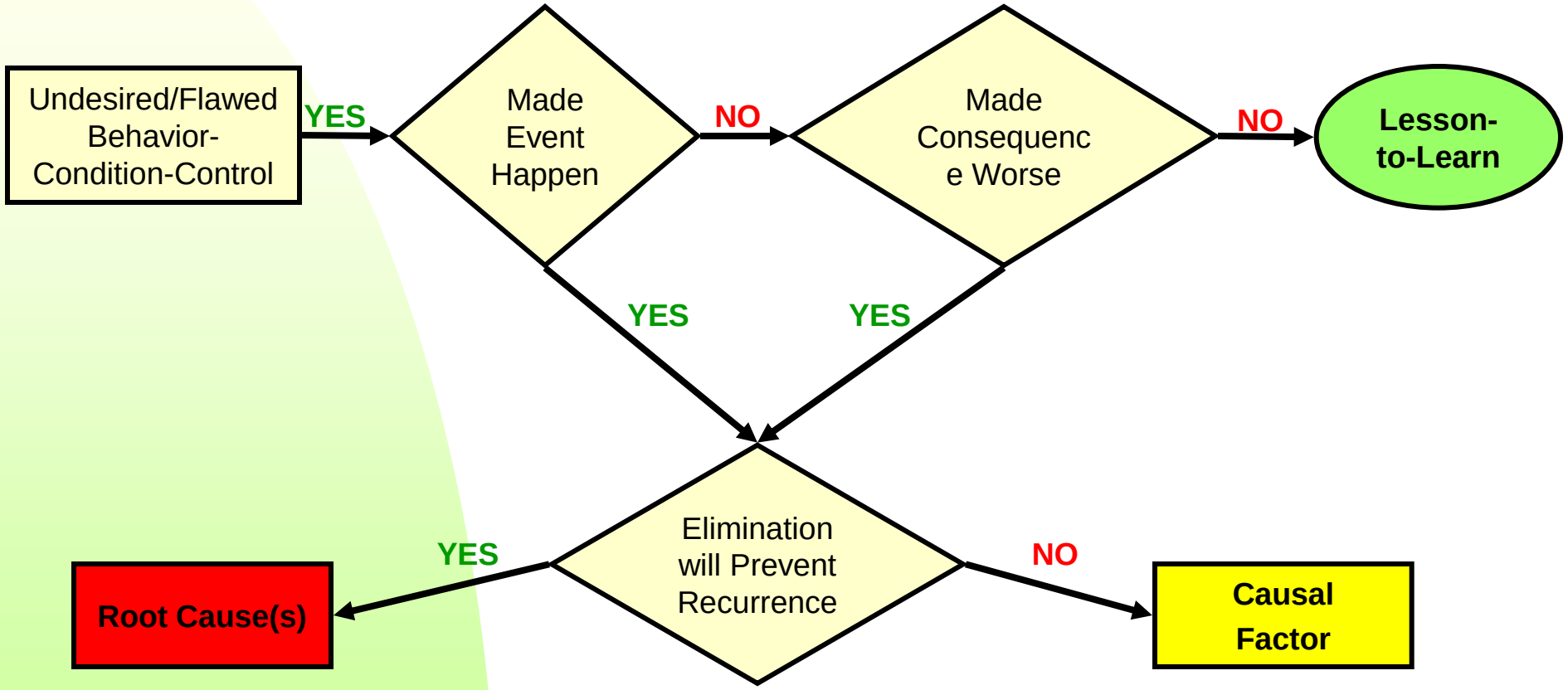
DOE Causal Analysis Guide

(DOE G 231.1-2)



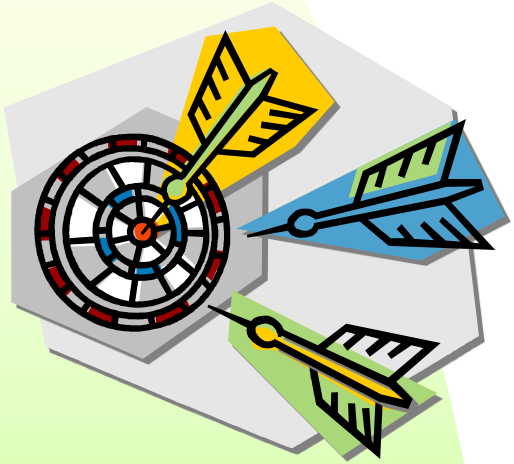
What's Important?

Test for Significant and Key Causal Factors



•Modified from W Corcoran & R Hartley 2007

Grading the Issues



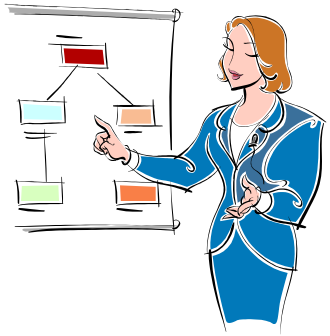
Small Team (1 or 2 people)	**A-B-C**
Medium Team (3–6 people)	**5 to 1**
Large Team (7 or more people)	**~Top 5!**

Types of Corrective Actions

Accommodational

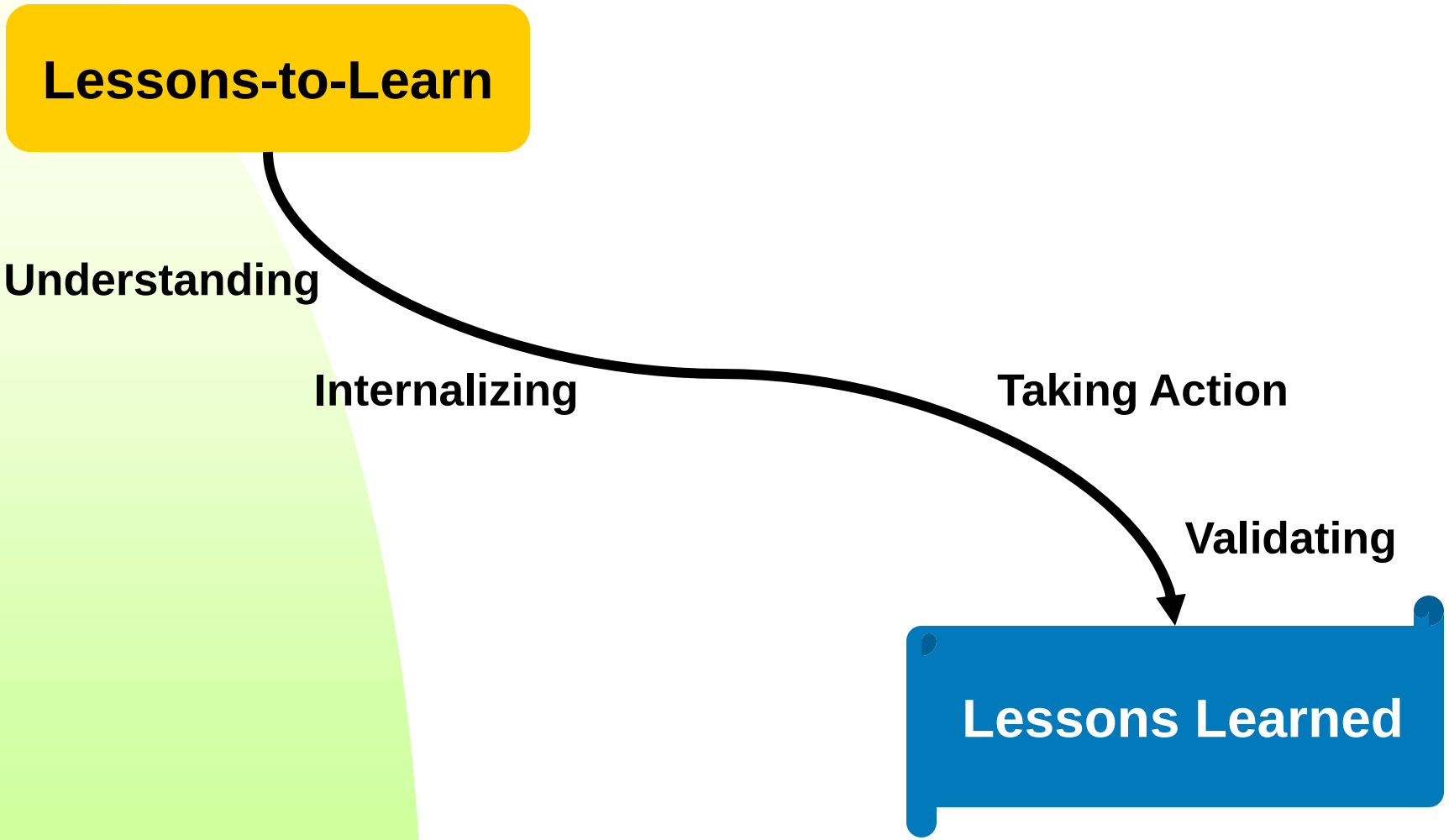
Ceremonial / Political

Symptomatic



Fundamental

Learning the Lessons



SMART Recommendations

- ✓ **Specific**
- ✓ **Measurable**
- ✓ **Agreed**
- ✓ **Realistic**
- ✓ **Time-bound**

Consider HPI Tools

DRAFT

Human Performance Tools for Individuals, Work Teams, and Management

A Good Practice Guide for
Anticipating, Preventing, and Catching
Human Errors and Identifying
Latent Organizational Weaknesses

HUMAN PERFORMANCE IMPROVEMENT
METHODS AND TECHNIQUES
November 2007

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Questions? Feedback!